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Indian Standard

SPECIFICATION FOR MAGNETIC AND CERAMIC PHONOGRAPH PICKUPS

(First Revision)

UDC 681·843·081·47/·48

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INDIAN STANDARDS INSTITUTION
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Indian Standard

SPECIFICATION FOR MAGNETIC AND CERAMIC PHONOGRAPH PICKUPS

(First Revision)

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(*Continued on page* 2)

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*Shri B. N. Banerjee was the Chairman for the meeting in which the standard was finalized.

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Indian Standard

SPECIFICATION FOR MAGNETIC AND CERAMIC PHONOGRAPH PICKUPS

(First Revision)

0. FOREWORD

0.1 This Indian Standard (First Revision) was adopted by the Indian Standards Institution on 3 November 1981, after the draft finalized by the Recording Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 This standard applies to phonograph pickups used for reproducing audio signals from gramophone records.

0.3 This standard was first published in 1971. This revision has been undertaken to update its requirements in the light of latest technological developments and taking into account the experience gained since its first publication.

0.4 For the characteristic 'Compliance', method of measurement has been given in this standard. The requirement for this characteristic will be incorporated in the standard after information is available.

0.5 In preparing this standard, assistance has been derived from the following documents:

IEC Publication 98 Processed disk records and reproducing equipment. International Electrotechnical Commission.

JIS C 5503 — 1967 Phonograph pickups. Japanese Industrial Standards, Japan.

REC 125 — A Phonograph pickups. Engineering Department, Radio Manufacturers' Association, USA.

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

---

*Rules for rounding off numerical values (*revised*).

1. SCOPE

1.1 This standard specifies the requirements and the methods of measurement for magnetic and ceramic phonograph pickups.

2. TERMINOLOGY

2.0 For the purpose of this standard, the following definitions in addition to those covered by IS : 1885 (Part XLVIII/Sec 2)-1978* shall apply.

2.1 Rated Speed of Rotation (of the Record) — The speed stated by the manufacturer at which a record should be played. The usual speeds are 77·92, 45·11 and 33·33 rpm.

2.2 Recorded Velocity — The alternating velocity imparted to a stylus tip of negligible dimensions fitted to a pickup having no mechanical impedance and tracing the groove of a record rotating with a constant angular velocity. It is represented by a vector with a lateral and vertical component for records with stereophonic recording.

Note — With a sinusoidal groove trace, the recorded velocity may be measured by the Buchman-Meyer lightband method. It should always be stated whether peak or rms values are implied.

2.3 Rated Termination Impedance — The pickup is considered to be terminated under rated conditions when the output terminals are connected to the rated load impedance as specified by the manufacturer.

2.4 Compliance — Ratio of the stylus tip displacement to the displacing force applied to the tip. The units are metres per newton.

Note — Assuming that the plane of the record is horizontal, one distinguishes between the lateral compliance and vertical compliance.

2.5 Frequency Characteristics — The output of a pickup when loaded by the rated termination impedance, and when reproducing the frequency ranges of a standard test record.

Note 1 — The output is expressed in decibels and is plotted as a function of frequency.

Note 2 — In the case of stereo pickup, the frequency response of each channel is given in graphical form.

2.6 Sensitivity (Monophonic Pickups) — If UmV is the output voltage of the pickup, when loaded by the rated termination impedance reproducing a reference signal of 1 kHz (from a standard test record) recorded at a velocity of V cm/s, then:

$$\text{Sensitivity at 1 kHz} = \frac{U}{V}\ \text{mV/cm/s or .... mV/}10^{-2}\text{m/s}$$

---

*Electrotechnical vocabulary: Part XLVIII Recording, Section 2 Disk recording [*Superseding* IS : 1885 (Part III/Sec 3)-1967].

NOTE — *Channel sensitivity* (*Stereophonic Pickup*) — The same definition applies, but the output voltage is measured at the terminals corresponding to those for either the left or the right channel. A standard stereophonic test record shall be used.

2.7 Channel Separation (Stereophonic Pickup only) — If S_L and S_R are two signals of identical recorded velocity and of frequency 1 kHz intended for left (L) and right (R) outputs respectively, then:

a) Channel separation (on left channel)

$$= 20 \log \frac{\text{Left output voltage due to } S_R}{\text{Left output voltage due to } S_L}, \text{ and}$$

b) Channel separation (on right channel)

$$= 20 \log \frac{\text{Right output voltage due to } S_L}{\text{Right output voltage due to } S_R}$$

The ratio is expressed in decibels.

NOTE 1 — The channel separation values will be negative.

NOTE 2 — The minimum channel separation at 1 kHz is the least negative of these two ratios.

2.8 Channel Separation Response (Stereophonic Pickup only) — The relative output levels (in dB) as a function of frequency of any given channel when activated by signals intended for the opposite channel.

2.9 Channel Unbalance — It specifies the difference in output level of the two stereo channels of the pickup.

2.10 Harmonic Distortion — As applied to phonograph pickups, it refers to any phenomenon that produces output signal component not in the record modulation.

3. CONSTRUCTION

3.1 The construction shall be mechanically stable and rugged and shall be capable of satisfactory operation in tropical climate.

3.2 If the pickup has two styli, one for coarse groove reproduction and the other for fine groove reproduction, it shall be possible to make the changeover easily.

4. MARKING

4.1 The pickup should have the following information marked legibly and indelibly:

a) Name of the manufacturer or his trade-mark,

b) Type and model,

c) Identification of the stylus, whether coarse or fine groove (mono or stereo),

d) Output electrical impedance,

e) Stylus pressure,

f) Sensitivity, and

g) Frequency response.

NOTE — The essential markings on the pickup shall be as given in (a), (b) and (c); other markings may be provided as printed matter and supplied along with the pickup.

4.1.1 The pickup or its carton may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

5. CLASSIFICATION OF TESTS

5.1 Type Tests — The procedure for type approval shall be in accordance with IS : 2612-1965*. The minimum number of samples for type tests shall be 10. The sequence of type tests shall be in accordance with Appendix A. There shall be no single failure in any of the type tests.

5.2 Acceptance Tests — The acceptance tests shall be carried out on a limited number of samples selected in accordance with the sampling procedure given in IS : 2612-1965* and which have passed the routine tests. The samples shall be subjected to the following tests in the order given below:

a) Sensitivity,

b) Channel separation (for stereo only), and

c) Frequency response.

5.3 Routine Tests — Each and every pickup shall be subjected to the following tests:

a) Sensitivity, and

b) Visual examination.

---

*Recommendation for type approval and sampling procedures for electronic components.

5.4 General Conditions for Tests

5.4.1 *Atmospheric Conditions for Tests* — Unless agreed upon otherwise, all measurements shall be made under the standard atmospheric conditions for testing as given in IS : 9000(Part I)-1977*.

6. MECHANICAL TESTS AND REQUIREMENTS

6.1 Visual Examination

6.1.1 The phonograph pickup shall be examined visually. There shall be no mechanical damage.

6.2 Drop Test

6.2.1 *Drop Test of Pickup Unit on a Record* — Pickup units shall be mounted on a standard arm which is raised till the point of the stylus is 50 mm above a record. Then the pickup unit shall be tested for 'fine groove' position. The turntable shall run at 45 rpm. The pickup arm shall then be adjusted to the maximum permissible stylus force recommended for the pickup unit. Then the stylus shall be dropped on to the record 10 times. After the test, the stylus shall not be damaged or become detached and the pickup unit shall still meet the requirements for the tests given in Appendix A, except the damp heat test.

6.2.2 *Drop Tests* (*for Units with Ceramic Elements*) — The conditions being the same as in **6.2.3**, the stylus shall be dropped 100 times on the record. The ceramic elements shall not break.

6.2.3 *Stylus Beside the Record on the Turntable Matt* — At the maximum permissible stylus force and at a speed of 45 rpm, the stylus shall run on a turntable matt beside a 17 cm record for 10 to 30 s, the turntable matt being made of rubber with a hardness of 50 ± 5 shore. After the test, the pickup unit shall meet the requirements for the tests given in Appendix A, except the damp heat test.

6.3 Stylus Tip Radius

6.3.1 In a plane perpendicular to the record surface and passing through a line joining the stylus tip to the record centre, the tip radius of the reproducing stylus shall be as follows:

a) *Coarse groove*:

Maximum 0·076 mm
Minimum 0·051 mm

---

*Basic environmental testing procedures for electronic and electrical items: Part I General.

b) *Fine groove*:

	Monophonic	*Stereophonic*
Maximum	0·025 mm	0·018 mm
Minimum	0·013 mm	0·013 mm

NOTE — For both monophonic and stereophonic application, the preferred range of tip radius should be:

from 0·015 mm, *Min*
to 0·018 mm, *Max*

6.4 Included Angle

6.4.1 In a plane perpendicular to the record surface and passing through a line joining the stylus tip to the record centre, the included angle of the reproducing stylus tip shall neither be greater than 55° nor less than 40°.

6.5 Stylus Tracking Force

6.5.1 The tracking force required for faithful reproduction shall be less than 0·078 N.

6.5.2 The tracking force can be measured by a balance. The measurement shall be performed with an accuracy better than ± 10 percent of the rated tracking force as stated by the manufacturer.

6.5.3 The tracking force shall be measured under playing conditions such that the stylus tip does not move more than 3 mm from the plane of the turntable.

6.5.4 In the case of automatic record changers, the stylus tip shall not move more than 3 mm from the plane of the topmost record when half the maximum number of records permitted on the record changer are on the turntable.

6.6 Compliance

6.6.1 *Lateral Compliance Coefficient*

6.6.1.1 The pickup head being immobile, a force is applied to the stylus tip, perpendicular to the plane of symmetry of the pickup head in such a way that the horizontal displacement of the stylus tip is not more than 100×10^{-6} m.

The force which caused this displacement is measured and the lateral compliance coefficient is calculated and given in metres per newton.

6.6.1.2 *Procedure for measurement of lateral compliance*:

a) The tracking force of the stylus tip is adjusted to its rated value;

b) An oscilloscope is connected to the output terminals of the pickup head;

c) A test record (*see* Appendix B) with a lateral recorded frequency of 400 Hz and an increasing range of peak velocities of 6, 9, 12, 14 and 16 cm/s is reproduced;

d) The shape of the signal on the screen of the oscilloscope is observed;

e) The tracking force of the stylus tip is adjusted to a value as close as possible to the recommended value given by the manufacturer in such a way that the beginning of the distortion of the signal appears for an exact value of the velocity (6, 9, 12, 14 and 16 cm/s peak velocity); and

f) The level at which the distortion starts to appear is noted.

NOTE — It should be checked whether the distortion is a result of losing the contact between the stylus tip and the groove. In this case, the distortion will diminish when the tracking force is increased.

6.6.1.3 From the results obtained, the compliance is calculated according to the following formula:

$$C = \frac{A}{F}$$

where

C = compliance in metres per newton,

A = amplitude of the signal in metres, and

F = tracking force of the stylus tip in newtons.

NOTE 1 — The amplitude A (expressed in metres) and the peak velocity v in cm/s of the recorded groove with 400 Hz are related according to $A = 4 \times 10^{-8} v$ within 0·5 percent.

NOTE 2 — Attention is drawn to the fact that this type of measurement is more related to the mechanical impedance than to the compliance as such because of the influence of the tone-arm mass and the damping.

6.6.2 *Vertical Compliance Coefficient*

6.6.2.1 A vertical force is applied through the vertical plane of symmetry of the pickup head and passing through the stylus tip at the front of the pickup head in such a way that the vertical displacement of the stylus tip is not more than 100×10^{-6}m. The force, which caused this displacement, is measured and the vertical compliance coefficient is calculated and given in metres per newton.

6.6.2.2 *Procedure for measurement of vertical compliance*

a) The procedure described for lateral compliance in **6.6.1.2** shall apply; and

b) A test record (*see* Appendix B) with vertical increasing velocities (2, 4, 6 and 8 cm/s peak velocity) shall be used without exceeding this value.

6.6.2.3 The compliance is calculated in accordance with the formula given in **6.6.1.3**.

7. ELECTRICAL TESTS AND REQUIREMENTS

7.1 Sensitivity (Channel Sensitivity) of a Pickup

7.1.1 *Monophonic Pickup* — The output terminals of the pickup are connected to the rated termination impedance and to a voltage measuring device having a high input impedance (not less than 2 megohms). A standard test record with a 1 000 Hz note of a known lateral recording velocity (V cm/s) is played. If U mV is the measured electrical output, then the sensitivity is:

$$\frac{U}{V}\ \mathrm{mV}/10^{-2}\mathrm{m/s}\ (\ \mathrm{mV/cm/s}\ )$$

NOTE — A list of standard test records is given in Appendix C.

7.1.1.1 The sensitivity of a ceramic pickup shall be better than 100 mV/10−2 m/s (100 mV/cm/s) when measured at an impedance of 1 MΩ in parallel with 100 pF′.

7.1.1.2 The sensitivity of a magnetic pickup shall be better than 2 mV/10−2 m/s (2 mV/cm/s) when measured at an impedance of 47 kΩ in parallel with 270 pF′.

7.1.2 *Stereophonic Pickup* — The above test is repeated using a standard stereophonic test record. The voltages at the left and right output channels are measured. The sensitivity of each channel is determined as in **7.1.1**.

NOTE — A list of standard test records is given in Appendix C.

7.1.2.1 The sensitivity of ceramic pickup shall be better than 50mV/10^{-2}m/s (50 mV/cm/s) when measured at an impedance of 1 M Ω in parallel with 100 pF′.

7.1.2.2 The sensitivity of a magnetic pickup shall be better than 1 mV/10^{-2}m/s (1 mV/cm/s) when measured at an impedance of 47 k Ω in parallel with 270 pF′.

7.2 Channel Separation (Stereophonic Pickup only)

7.2.1 A standard stereophonic test record having grooves with identical 1 kHz signals recorded only on the left channel (S_L) or the right channel (S_R) shall be used.

NOTE — A list of standard test records is given in Appendix C.

7.2.2 Measurement method of **7.1.2** shall be used. The voltage is measured at the left output terminals when activated by S_R and S_L. Next the voltage is measured at the right output terminals when activated by S_R and S_L:

a) Channel separation (in dB) on left channel

$$= 20 \log \frac{\text{Left output voltage due to } S_R}{\text{Left output voltage due to } S_L}, \text{ and}$$

b) Channel separation (in dB) on right channel

$$= 20 \log \frac{\text{Right output voltage due to } S_L}{\text{Right output voltage due to } S_R}$$

7.2.3 The minimum separation at 1 kHz is the least negative of the ratios.

7.2.4 The minimum separation at 1 kHz shall be better than 16 dB.

7.3 Channel Unbalance (Stereophonic Pickups only)

7.3.1 Measurement methods of **7.1.2** and **7.2** shall be used.

7.3.2 The channel unbalance (in dB) at 1 kHz

$$= 20 \log \frac{\text{Left output voltage due to } S_L}{\text{Right output voltage due to } S_R}$$

7.3.3 The channel unbalance at 1 kHz shall not exceed 3 dB.

7.4 Frequency Response

7.4.1 *Monophonic Pickup*

7.4.1.1 Measurement method of **7.1.1** shall be used.

7.4.1.2 A standard test record is played, which carries either fixed or swept frequencies laterally cut.

7.4.1.3 The variations in the level of the output voltage are measured as a function of the frequency. The voltage levels are expressed in decibels relative to the value obtained at the frequency of 1 kHz.

7.4.1.4 The variations in output level (in decibels) as a function of frequency may be shown by a graph.

7.4.2 *Stereophonic Pickup*

7.4.2.1 Measurement methods of **7.1.1** and **7.1.2** shall be used.

7.4.2.2 A standard test record is played, which carries either fixed or swept frequencies intended for the channel to be measured.

NOTE — A list of standard test records is given in Appendix C.

7.4.2.3 The variations in the level of the output voltage are measured as a function of the frequency. The voltage levels are expressed in decibels relative to the value obtained at the frequency of 1 kHz.

7.4.2.4 The variations in output levels (in decibels) as a function of frequency, for each channel, may be shown by a graph.

7.4.3 The total electrical capacitance of the connecting cable and the measuring instruments should not exceed 10 pF, and its value shall be stated.

7.4.4 The frequency response of a magnetic pickup is proportional to the recorded velocity. The electrical output of such a pickup should follow the rated recording characteristic at least from 60 Hz to 10 kHz, within ± 3 dB with respect to 1 kHz. The rated recording characteristic is given by the manufacturer of the test record.

7.4.5 The frequency response of a ceramic pickup is proportional to the amplitude of the recorded signal. Hence, the output of the ceramic pickup should be uniformly flat, within a tolerance of ± 3 dB with respect to 1 kHz from 60 Hz to 10 kHz.

7.5 Source Capacitance — When measured by a suitable method, the source capacitance shall be 600 pF ± 15 percent.

7.6 Insulation Resistance — The insulation resistance shall be measured with a dc voltage 100 ± 15 V applied for a period of 1 mm ± 5 s.

7.6.1 *Magnetic Pickups* — For pickups having two independent coils, the insulation resistance shall be 5 M Ω minimum when measured between both coils.

For pickup in which the coil is not connected to the outward exposed metal, the insulation resistance shall be 10 M Ω minimum, when measured between the coil and the exposed metal surface.

7.6.2 *Ceramic Pickup* — The insulation resistance shall be 5 M Ω minimum when measured between two terminals of the same piezo-electric element.

For the pickup having two independent piezo-electric elements, the insulation resistance shall be 10 M Ω minimum when measured between both elements.

For the pickup in which the piezo-electric element is not connected to the outward exposed metal, the insulation resistance shall be 10 M Ω minimum when measured between the element and the exposed metal surface.

8. CLIMATIC TEST

8.1 Damp Heat (Accelerated) Test (One Cycle) — The pickup shall be subjected to this test in accordance with IS : 9000(Part V)-1981*. The temperature of the chamber shall be 50°C and the relative humidity shall be between 95 and 100 percent.

After the test, the pickup shall be taken out of the chamber and shall be kept under standard recovery conditions for 24 h.

After recovery, the insulation resistance shall be measured in accordance with **7.6**. It shall be greater than 1 MΩ.

APPENDIX A

(*Clause* 5.1)

SEQUENCE OF TYPE TEST

A-1. The sequence of the type tests shall be as follows:

a) Visual examination (**6.1**),
b) Construction (**6.2**),
c) Stylus tip radius (**6.3**),
d) Included angle (**6.4**),
e) Stylus tracking force (**6.5**),
f) Compliance (**6.6**),
g) Sensitivity (**7.1**),
h) Channel separation (**7.2**),
j) Channel unbalance (**7.3**),
k) Frequency characteristics (**7.4**),
m) Source capacitance (**7.5**),
n) Insulation resistance (**7.6**), and
p) Damp heat (accelerated) (**8**).

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*Basic environmental testing procedure for electronic and electrical items: Part V Damp heat (cycle) test.

APPENDIX B

[*Clauses* 6.6.1.2(c) *and* 6.6.2.2(b)]

TEST RECORD FOR THE MEASUREMENT OF THE COMPLIANCE COEFFICIENT OF THE STYLUS TIP

The record shall be of a 33⅓ rpm type with a diameter of 30 cm. The cutting angle shall be 20 deg.

A 400 Hz signal, lateral cut with peak amplitudes of 40-50-63-80-100 mm in 5 bands separated by marker spaces from outer to inner side of the record with a duration of 20s/band. These amplitudes correspond to the peak velocities of 10·04 — 12·56 — 20·09 — 25·12 cm/s. These bands are separated by a larger marker space from the following vertical cut test bands.

A 400 Hz test signal, vertical cut with peak amplitudes of 10-20-30-40-50 cm in 5 bands separated by marker spaces from outer to inner side of the record and a duration of 30s/band. The amplitudes correspond to the peak velocities of 2·51 — 5·02 — 7·53 — 10·04 — 12·56 cm/s.

The recorded surface ends with a lead out groove and a concentric finishing groove. The cutting distortion, both lateral and vertical, shall be less than 2 percent, regardless of the velocity used.

APPENDIX C

(*Clauses* 7.1.1, 7.1.2, 7.2.1, 7.4.1.2 *and* 7.4.2.2)

LIST OF TEST RECORDS

CATALOGUE NUMBER	COUNTRY OF ORIGIN	NAME OF MANUFACTURER	MODULATION	SPEED OF ROTATION rpm
STR 100	USA	CBS	Left, right	33⅓
TCS 101*	UK	EMI	Left, right	33⅓
TCS 104*	UK	EMI	Lateral	33⅓
TCS 105	UK	EMI	Vertical	33⅓
SXL 2057	UK	Decca	Left, right	33⅓
LXT 5346	UK	Decca	Lateral	33⅓
DIN 45541	Germany	D.G.G.	Left, right, lateral	33⅓
QR 2009	Denmark	B & K	Left, right, lateral, vertical	45
STR 120	USA	CBS	Left, right, lateral, vertical	33⅓
STR 130	USA	CBS	Left, right, lateral	33⅓

*Available in India (Manufactured and marketed by M/s The Gramophone Co of India Ltd).

INDIAN STANDARDS

ON

RECORDING

IS:

1885 (Part XLVIII/Sec 1)-1978 Electrotechnical vocabulary: Part XLVIII Recording, Section 1 Tape recording [*Superseding* IS : 1885 (Part III/Sec 3)-1967]

1885 (Part XLVIII/Sec 2)-1978 Electrotechnical vocabulary: Part XLVIII Recording, Section 2 Disk recording [*Superseding* IS : 1885 (Part III/Sec 3)-1967]

2032 (Part XII)-1969 Graphical symbols used in electrotechnology: Part XII Electroacoustic transducers and recording and reproducing systems

3956-1967 Dimensions of spools for magnetic tapes for sound recording and reproduction

*4377-1967 General requirements for magnetic tapes for sound recording and reproduction

4379-1967 Methods of measurement on magnetic tapes for sound recording and reproduction

4480 (Part I)-1967 Magnetic tapes for sound recording and reproduction: Part I Domestic grade

4480 (Part II)-1974 Magnetic tapes for sound recording and reproduction: Part II Professional grade

*6370-1981 Tape cassettes for domestic use

6391-1971 Magnetic and ceramic phonograph pick-ups

7068-1973 6·25 mm calibration tape

7594 (Part I)-1978 Magnetic sound tape recording and reproducing equipment (cassette): Part I Methods of measurement

7594 (Part II)-1979 Magnetic sound tape recording and reproducing equipment (cassette): Part II Domestic type

8152-1976 Method of measurement of speed fluctuations in sound recording and reproducing equipment

8234-1976 Spools for magnetic tapes for sound recording and reproduction

8655 (Part I)-1977 Magnetic sound tape recording and reproducing equipment (reel-to-reel): Part I Methods of measurement

8655 (Part III)-1977 Magnetic sound tape recording and reproducing equipment (reel-to-reel): Part III Professional type

9272 (Part I)-1979 Disk record playing equipment: Part I Record player

9272 (Part II)-1979 Disk record playing equipment: Part II Amplifiers and loudspeakers

9305-1979 Processed disk records

9551 (Part IV)-1980 High fidelity audio equipment and systems : Part IV Record playing equipment and cartridges

9551 (Part V)-1980 High fidelity audio equipment and systems: Part V Magnetic sound tape recording and reproducing equipment

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*Under revision.

INTERNATIONAL SYSTEM OF UNITS (SI UNITS)

Base Units

Quantity	*Unit*	*Symbol*
Length	metre	m
Mass	kilogram	kg
Time	second	s
Electric current	ampere	A
Thermodynamic temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Supplementary Units

Quantity	*Unit*	*Symbol*
Plane angle	radian	rad
Solid angle	steradian	sr

Derived Units

Quantity	*Unit*	*Symbol*	*Definition*
Force	newton	N	$1\ \mathrm{N} = 1\ \mathrm{kg.m/s^2}$
Energy	joule	J	$1\ \mathrm{J} = 1\ \mathrm{N.m}$
Power	watt	W	$1\ \mathrm{W} = 1\ \mathrm{J/s}$
Flux	weber	Wb	$1\ \mathrm{Wb} = 1\ \mathrm{V.s}$
Flux density	tesla	T	$1\ \mathrm{T} = 1\ \mathrm{Wb/m^2}$
Frequency	hertz	Hz	$1\ \mathrm{Hz} = 1\ \mathrm{c/s}\ (\mathrm{s^{-1}})$
Electric conductance	siemens	S	$1\ \mathrm{S} = 1\ \mathrm{A/V}$
Electromotive force	volt	V	$1\ \mathrm{V} = 1\ \mathrm{W/A}$
Pressure, stress	pascal	Pa	$1\ \mathrm{Pa} = 1\ \mathrm{N/m^2}$

INDIAN STANDARDS INSTITUTION

Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002

Telephones : 26 60 21, 27 01 31 **Telegrams : Manaksanstha**

Regional Offices:

			Telephone
Western	: Novelty Chambers, Grant Road	BOMBAY 400007	37 97 29
Eastern	: 5 Chowringhee Approach	CALCUTTA 700072	27 50 90
Southern	: C. I. T. Campus, Adyar	MADRAS 600020	41 24 42
Northern	: B69 Phase VII	S. A. S. NAGAR (MOHALI) 160051	—

Branch Offices:

'Pushpak', Nurmohamed Shaikh Marg, Khanpur	AHMADABAD 380001	2 03 91
'F' Block, Unity Bldg, Narasimharaja Square	BANGALORE 560002	2 76 49
Gangotri Complex, Bhadbhada Road, T. T. Nagar	BHOPAL 462003	6 27 16
22E Kalpana Area	BHUBANESHWAR 751014	5 36 27
5-8-56C L. N. Gupta Marg	HYDERABAD 500001	22 10 83
R14 Yudhister Marg, C Scheme	JAIPUR 302005	6 98 32
117/418 B Sarvodaya Nagar	KANPUR 208005	4 72 92
Patliputra Industrial Estate	PATNA 800013	6 28 08
Hantex Bldg (2nd Floor), Rly Station Road	TRIVANDRUM 695001	82 27

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